US PTO 99-0390 DD 215706

Translated from the German

German Democratic Republic
Economic Patent
Patent Specification
DD 215 706 A1
IPC: B 01 D 53/34
Office for Inventions and Patents
date of application: May 30, 1983
Date of making available to the public of the examined document, on which no grant or only a provisional grant has taken place on or before the said date: November 21, 1984
Applicant: VEB ZFT Mikroelektronik
Inventor: Christian Ränsch
Title in German: Verfahren und Vorrichtung zum Reinigen von Gasen und Dämpfen aus Plasmaanlagen

METHOD AND DEVICE FOR THE PURIFICATION OF GASES AND VAPORS FROM PLASMA INSTALLATIONS

(57) The purification method in accordance with the invention is used for the purification of exhaust gases from the plasma process, which gases originate in the case of plasma installations, such as, e.g., in the case of plasma-chemical etching of substrate for the microelectronics. It is an object of the invention to purify with a high degree of efficiency deleterious gases and vapors, accumulating over the course of plasma-chemical etching. The essence of the invention consists in the fact that the gases and vapors are conveyed between plasma reactor and vacuum pump system by means of a reaction material,

which is heated, by being subjected to the action of a plasma, and dedusted or wiped off the dust, as a result of which the contact surfaces of the reaction material are continuously renewed.

*

* *

* *

Area of Application of the Invention

The purification method in accordance with the invention is used for the purification of exhaust gases from the plasma process, which originate in plasma installations, such as, e.g, in the case of plasma-chemical etching of substrate for the microelectronics.

Characteristic of the Known Technical Solutions

The purification of gases and vapors, originating in the case of plasma-chemical etching processes, is required prior to the entrance into the pump system, which sucks off these gases and vapors, in order for the vacuum pumps to be protected against corrosion. In addition to this, it is required that these partially toxic gases and vapors are purified for reasons related to the protection of the environment.

A known method for the purification of the gases and vapors consists in that a deep-cooling [low-temperature] trap is

arranged between plasma reactor and vacuum pump, in which deep-cooling trap the gases and vapors are converted to the solid state of aggregation. That method has the disadvantage that for the purpose of purification of the deep-cooling trap, the frozen gases and vapors are brought once again in the vapor phase, and should be withdrawn by means of a separate exhaust-gas system. In that case, the required continuous replacement of the deep-cooling medium is also disadvantageous.

It has already been proposed (WP B 01 D/238 797), to convert the chlorine compounds, accumulating in the case of the plasma-chemical etching process of aluminum with the help of carbon tetrachloride [tetrachloromethane], on an iron surface (iron filings) heated to about 500°C, into iron (III) chloride. That method, which is perfect to the purification of such exhaust or waste gases has the disadvantage that it requires a great energy input, in order for the necessary reaction temperature of about 500°C to be maintained. Another imperfection consists in that due to the high temperatures, the iron (III) chloride vaporizes, and is evacuated by being concurrently pumped off. Therefore, a contamination of the operating fluid [pump oil] cannot be prevented. Moreover, in view of the high temperatures, yet another cooling device should be installed in front of the vacuum pump.

Object of the Invention

It is an object of the invention to purify with a high efficiency the harmful gases and vapors, accumulating in the case of plasma-chemical etching.

Explanation of the Essence of the Invention

The task to create a method and a device, corresponding thereto, for the purification of gases and vapors, which accumulate in plasma installations, such as, e.g, in the case of plasma-chemical etching of Si-substrates, which method allows that these gases and vapors are formed in a way, which requires an essentially low energy input and low maintenance, and is efficient, forms the basis of the invention.

In accordance with the invention, this task is resolved in such a way that the exhaust or waste gases are conveyed in already proposed way between plasma reactor and vacuum pump system by means of a reaction material, which is heated and dedusted as a result of being acted upon by a plasma, as a result of which the contact surfaces of the reaction material are continuously renewed. In an advantageous way, a controllable or adjustable flow of inert gas is added to the reactive plasma for the purpose of a control of the purification method. Iron, having plane geometry, is preferably used as reaction agent.

For the carrying out of the method in accordance with the invention, a pot-shaped container is used, which contains the reaction agent, which pot-shaped container is characterized in that a metal plate, in its capacity as reaction agent, is

arranged in the pot-shaped container by means of an insulating bushing, and that the metal plate is connected with one pole to a source of voltage and the pot-shaped container is connected with the other pole to the source of voltage.

The advantages of the solution in accordance with the invention consist in that the reaction material is heated up and simultaneously dedusted by means of the reactive plasma, as a result of which essentially less energy is required for the heating of the reaction material than in the case of the known heating methods so that besides iron, other materials, such as e.g., Al or Cu, can also be used. Moreover, the purification process is improved as a result of the continuous dedusting of the reaction surfaces.

Exemplified Embodiment

For the materialization of the method in accordance with the invention, the device, represented in the drawing, is used.

For the sake of simplicity, the method is elucidated by means of the mode of operation of the device.

The purification unit consists of the pot-shaped container 1, which is closed by means of the lid 2 and vacuum seal 3. In addition to this, the container is provided with a inlet connecting branch 7 and an outlet connecting branch 8. . By means of these inlet and outlet connecting branches, the purification unit if the exhaust or waste gas pipeline of a plasma installation, which is not represented, is arranged so that it is

located between plasma reactor and vacuum-pump system. In the container 1, the reaction material, consisting of a metal plate 5, is isolated with respect to the container 1 by means of the insulting bushing 4. The metal plate 5 is operationally connected to the pole of the voltage source 6. The other pole of the source 6 of voltage is connected to the container 1. An inert-gas supply pipe 7 having a valve 10 is installed on the inlet connecting branch 7.

The mode of operation of the method is as follows.

As a result of the pressure difference between plasma reactor and vacuum pump system, the gases and vapors, accumulating in the plasma reactor over the course of the etching process, are conveyed into the container 1. With the help of the power source 6, a plasma is generated in the container 1,, which plasma is built up on all sides between the metal plate 5 and the inner wall system of the container. By means of this reactive plasma, the metal plate 5 is heated up, and is continuously dedusted. If the metal plate consists, e.g., of iron, then the chlorine-containing compounds of the etching-process waste-gas react or are converted into iron (III) chloride. Due to the ion bombardments of the surfaces of the metal plate 5, which ion bombardments occur as a result of the plasma, material is continuously removed from theses surfaces. This leads to a continuous renewal or regeneration of the surfaces, and to heating of the metal plate 5. The heating of the metal plate 5 (iron plate) is kept under the boiling point of the iron (III)

chloride so that the latter precipitates as solid component on the walls of the pot-shaped container 1. After longer operating time, the reaction material is regenerated, and the container 1 is cleaned from the accumulated reaction product. To this end, it is necessary that the lid 2 is merely detached from the container 1, and a new metal plate 5 is installed into the container 1.

Instead of iron, other metals, such as aluminum, copper, etc, can also be used as reaction material. As a result of the introduction of an inert gas, an acceleration of the purification process takes place in the container 1, because as a result of this the energy input also increases.

C L A I M S

1. Method for the purification of gases and vapors from plasma installations, such as, e.g., waste or exhaust gases , which accumulate in the case of plasma-chemical etching of Si-substrates, characterized in that the waste gases are conveyed in already proposed way between plasma reactor and vacuum-pump system by means of a reaction material, which is heated up and dedusted as a result of being acted upon by a plasma, as a result of which the contact surfaces of the reaction material are continuously regenerated or renewed.

2.Method for the purification of gases and vapors as claimed in claim 1, characterized in that for the purpose of control of

the purification process, a controllable flow of inert gas is added to the reactive plasma.

3. Method for the purification of gases and vapors as claimed in claims 1 and 2, characterized in that iron, having plane geometry, is used as reaction material.

4. Device for the purification of gases and vapors, essentially consisting of a pot-shaped container having inlet and outlet connecting branches [pipelines], which container contains the reaction material, and is used for the carrying out of the method in accordance with the claims 1 thru 3, characterized in that in its capacity as reaction material, a metal plate (5) is arranged in the pot-shaped container 91), and that the metal plate (5) is connected with a pole to a source of voltage (6) and the pot-shaped container (1) is connected with the other pole to the source of voltage (6).

5. Device as claimed in claim 4, characterized in that the metal plate (5) consists of iron.

US PATENT & TRADEMARK OFFICE
Translations Branch
November 3, 1998
John M Koytcheff